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LABORATORY EVALUATION OF CROWN AND BRIDGE TEMPORARY RESINS,(U)
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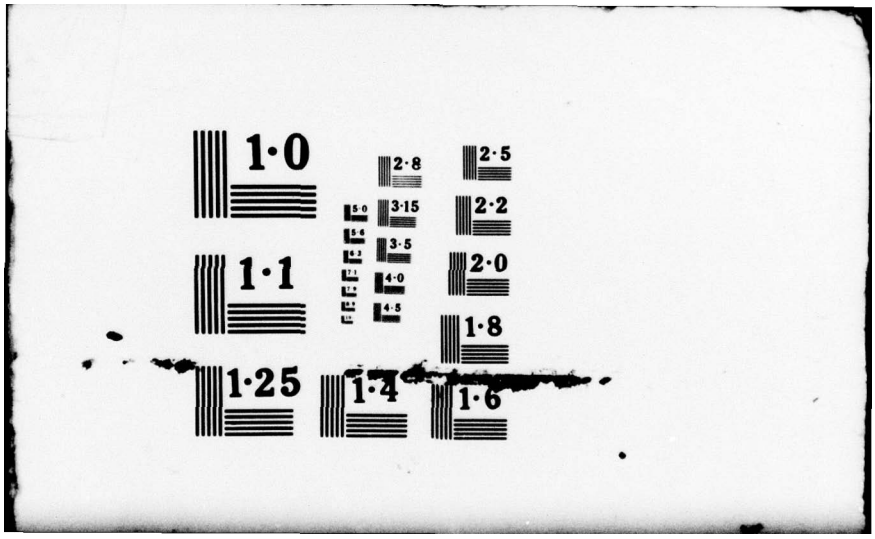
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The characteristics of two resins used for the fabrication of interim restorations were assessed. Clinically significant differences in the mechanical properties of the two products were not observed. However, one material exhibited markedly reduced polymerization shrinkage.

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LABORATORY EVALUATION OF CROWN AND BRIDGE TEMPORARY RESINS

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LABORATORY EVALUATION OF CROWN AND BRIDGE TEMPORARY RESINS

The successful restoration of damaged and missing teeth with precision cast dental prostheses requires the use of temporary restorations to maintain tooth form and function during the laboratory phase of prosthetic reconstruction. These interim restorations must possess dimensional and mechanical characteristics sufficient to protect the teeth and supporting structures during mastication.

Historically, resin based materials have been used for direct fabrication of temporary crowns and bridges. Products with seemingly similar characteristics have been marketed under a variety of proprietary names. Divergent claims of product superiority have become sources of confusion to many dental personnel. Therefore, the present study was initiated to ascertain and compare the properties of two resin based temporary restoratives.*

Materials and Methods

The test resins were obtained commercially. Dispensing and mixing of the powder and liquid components was accomplished in accordance with their respective manufacturer's instructions. Powder-liquid ratios were established by weight from recommended volumetric proportions.

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* Material A, Jet Tooth Shade Acrylic, Lang Dental Manufacturing Co., Chicago, IL 60610.

Material B, Snap Self-Curing Resin for Temporaries, Parkell, Bio-Materials Division, Farmingdale, NY 11735.

Mixed slurries of each material were packed into split molds for the fabrication of tensile specimens. Dimensions of the specimens were within the tolerances prescribed by American Dental Association Specification No. 14 for chromium-cobalt casting alloy.[1] Tensile properties were measured on a constant strain rate testing machine[#] at a crosshead speed of 0.1-inch per minute. Elongation was measured over a one-inch gauge length with a breakaway extensometer.[§] Six trials were made for each test resin.

Specimens for the determination of hardness were 13 mm X 3 mm discs formed in stainless steel molds. The specimens were cured at 37C and 100 percent relative humidity in contact with a glass plate to insure a smooth test surface. Ten minutes after the start of mixing, the glass plate was removed and the specimens subjected to microhardness measurements with the use of a testing machine[¶] equipped with a Knoop indenter. Subsequent hardness measurements were made at 1 hour, 8 hours, and 24 hours after the start of mixing. Three specimens were made for each material. Reported hardness values are means of 20 measurements on each specimen at each time period.

Instron Universal Testing Machine, Instron Engineering Corp., Canton, MA 02021.

§ Strain Gauge Extensometer, Model LG-51-12, Instron Engineering Corp., MA 02021.

¶ Kentrall Hardness Tester, Model MC-1, Riehle Testing Machines, East Moline, IL 61244.

Cylinders, approximately 6 mm in diameter and 12 mm in length were used for the determination of polymerization shrinkage. The volumes of the specimens were determined by water displacement. Polymerization shrinkage was calculated as a percentage of the measured volume of the Teflon mold from which the test pieces were made.

Polymerization peak temperature and hardening time was determined on 12 mm X 12 mm cylindrical specimens by the procedures outlined in American Dental Association Specification No. 17 for denture base temporary relining resin.[2]

Results

The apparent mechanical properties of the test resins are summarized in Table I. In general, the strength properties of material A were higher than those exhibited by material B. Ultimate tensile strengths ranged from 3,600 psi for B to 5,600 psi for A. The elastic limit of material A was about twice that of material B. However, the modulus of elasticity of material B (3.2×10^5 psi) was about 50 percent higher than that observed with material A.

The hardening properties of the test resins are summarized in Table II. Polymerization peak temperatures were 40C and 45C for B and A respectively. The polymerization shrinkage of the two resins was markedly different. The volumetric change during setting ranged from 0.26 percent for material B to 4.96 percent for material A. Hardness values of the two resins, on the other hand, were similar. Both materials exhibited a Knoop hardness of eight measured at ten minutes after the beginning of mixing. Surface hardness did not appear to increase appreciably

with time. Twenty-four-hour hardness values ranged from eight for B to eleven for A. The hardening time for each material was seven minutes.

Discussion

The suitability of a resin material for the direct fabrication of temporary fixed prosthetic restorations is dependent upon several factors. Strength, rigidity and surface hardness of the set material, peak polymerization temperature, hardening time and polymerization shrinkage influence the rational selection of interim prosthetic materials. Unfortunately, a range of values for these properties, as reliable indicators of clinical performance, has not been established.

The higher strength observed with material A suggests a resin more resistant to fracture during function. On the other hand, the higher modulus of elasticity (rigidity) exhibited by material B may indicate a preferential application in the fabrication of a long span temporary bridge. It is questionable, however, whether the differences in the mechanical properties of the test resins would be discernible clinically.

It has been suggested that materials exhibiting peak polymerization temperatures of 50C or less are suitable for intraoral use.[3] Obviously variations in powder-liquid ratio and specimen geometry affect the magnitude of the measured peak polymerization temperature. Specimens employed in the present study approximate the powder-liquid ratio and amount of material used in the construction of a temporary crown. Peak temperatures in the 40 to 45C range would appear to provide an adequate margin of safety to minimize pulpal effects. Judicious technique dictates, however, that the temporary restoration be removed from the prepared tooth during the time of

occurrence of the peak temperature.

Polymerization shrinkage drastically affects the fit and function of a temporary restoration. Clinically, the interim bridge or crown often requires internal relief and occlusal additions of material prior to cementation to provide acceptable fit and function. The marked reduction in polymerization shrinkage exhibited by material B may minimize the need for these minor adjustments.

Summary

The characteristics of two resins used for the fabrication of interim restorations were assessed. Clinically significant differences in the mechanical properties of the two products were not observed. However, one material exhibited markedly reduced polymerization shrinkage.

References

1. American Dental Association: Guide to Dental Materials and Devices. 7th ed., Chicago, Am Dent Assoc, 1974, pp 209-211.

2. American Dental Association: Guide to Dental Materials and Devices. 7th ed., Chicago, Am Dent Assoc, 1974, pp 217-219.

3. Civjan, Simon; Rapheld, T. V.; and Richard, R. L. Suitability of Commercial Cold-Curing Resins for Direct Intraoral Splinting. JADA 83:1058-1062, November 1971.

TABLE I: Apparent Mechanical Properties of Temporary Crown and Bridge Resins

Material	Ultimate Tensile Strength (psi)	Yield Strength (psi)	Elastic Limit (psi)	Modulus of Elasticity ($X10^5$ psi)	Elongation %
A	5,600±400	4,800±400	2,800±600	2.0±0.3	2.4±0.6
B	3,600±700	2,900±300	1,500±300	3.2±0.2	2.2±0.2

TABLE II: Hardening Properties of Temporary Crown and Bridge Resins

Material	Polymerization Peak Temperature (C)	Hardening Time* (min)	Polymerization Shrinkage (%)	Hardness (KHN) 10 min	1 hr	8 hr	24 hrs
A	45±1	7.0±0.3	4.96	8±1	8±1	9±1	11±1
B	40±1	7.0±0.4	0.26	8±1	8±1	8±1	8±1

* Time of occurrence of the polymerization peak temperature.